ORIGINAL ARTICLES

THE SURGICAL TREATMENT OF LESIONS OF THE STOMACH AND DUODENUM*

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GASTRIC and Duodenal Ulcer. — A clear-cut distinction between gastric and duodenal ulcer was not made until late in the twentieth century, although reports in the literature indicate that gastric ulcer was recognized as early as 1600, and that two cases of duodenal ulcer were recorded in 1817. Evidently many of the diseases that constitute the problems of today were known to the men of ancient times. The magnitude of the problem of peptic ulcer alone may be calculated to some extent by the fact that in a period of twenty-six years we found it necessary at The Mayo Clinic to operate on about 3,000 patients for gastric ulcer, and in a period of twenty-eight years almost 13,000 patients underwent operation for duodenal ulcer. These figures, obviously, do not take into account those persons who harbored healed duodenal ulcer, those whose symptoms were controlled by dietary measures, or those who had such slight digestive disturbance that they preferred to tolerate the distress rather than to submit to any inconvenience that might result from adoption of a dietary regimen.

PATHOGENESIS OF GASTRIC AND DUODENAL ULCERS

The causes of gastric ulcer and of duodenal ulcer undoubtedly are somewhat allied. The fact that stands out as a dividing line is the extreme rarity of malignancy in the duodenum, and the relative frequency of lesions of that nature in the stomach. In the few cases of primary malignancy of the duodenum that have been reported, it has been difficult to prove that the disease has been a sequel of chronic duodenal ulcer. Experience with lesions of the stomach indicates that there must be some association between chronic gastric ulcer and certain forms of malignancy found in the stomach. Often it is impossible to distinguish between carcinomatous gastric ulcer and ulcerating carcinoma until microscopic study of the tissue is made. In about 19 per cent of the cases of gastric ulcer, the lesion was malignant. According to the experience of some pathologists, a gastric ulcer 2.5 centimeters or more in diameter is likely to have undergone malignant change. It might further be stated that the presence of carcinoma in lesions less than one centimeter in diameter has been demonstrated sufficiently often to preclude dismissing the possibility of carcinoma being present in small gastric ulcers. In specific instances there is much to suggest that the malignant process is the sequel of a chronic gastric ulcer.

It is logical to think that a better understanding of the whole situation should be gained through experimental work with animals, but the work has been impeded by the fact that benign ulcer of the stomach and of the duodenum are peculiar to man. It has never been difficult to produce an acute ulcer of the stomach experimentally, but only in recent times has it been possible to cause chronic ulcer at will, as has been accomplished by Mann, Dragstedt, and others. Matthews and Dragstedt concluded that the chemical action of pepsin-hydrochloric acid is the outstanding factor in the production of acute, and subsequently of chronic, ulcer; although gastric motility, trauma to the mucosa, and general systemic conditions help to promote progress of the process. Heredity may also play an important part in the development of ulcer. Perhaps, in some instances, infection of toxins exert considerable influence. Wilkie, after observation and study, expressed the belief that too much emphasis cannot be placed on irregular habits of living as a causative element. According to our experience at the clinic, only in a few cases can gastric ulcer definitely be traced to ingestion of ordinary chemicals. However, in a series of experiments carried out in an attempt to reproduce the changes in the liver which result from use of cinchophen, Bollman found that gastric ulcer developed in some of the dogs after the use of the drug.

Knowledge of the pathogenesis of ulcer does not progress rapidly, in spite of the vast amount of effort to solve the problem. In accordance with present knowledge, the logical treatment of peptic ulcer, whether medical or surgical, must be directed toward correction of the known etiologic factors.

TREATMENT

As soon as gastric and duodenal ulcer were thought of as distinct entities, and the possibility of malignant change in association with gastric ulcer was recognized, treatment of the two conditions took diverse paths. Up to this time no clinical or roentgenographic criteria have been found which will allow determination of whether or not there is a malignant lesion in the border of a chronic gastric ulcer; and so it is evident that the lesions must be removed before their exact nature can be determined.

In a few cases in which there is reason to believe that a gastric lesion is benign, there might be justification for trying medical and dietary management, provided that the patient can be kept under close observation. However, anyone who advises adoption of this plan should keep the possibility of malignant transformation foremost in his mind, and should be sure that later he can obtain the patient's prompt and willing acceptance of an operation, in the event experience indicates that this is the outstanding requirement. The immediate operative mortality rate among patients who have benign gastric ulcer is about half that encountered among patients whose lesions have undergone malignant change. Another interesting observation is that jejunal ulcer is relatively uncommon following surgical procedures employed for removal of gastric ulcer (twenty in a series of 597 cases of proved jejunal ulcer). The more

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the situation is studied, the more is the observer impressed with the fact that an ulcer of the stomach imposes a problem very different from that of an ulcer of the duodenum, from the experimental standpoint as well as from the clinical and surgical aspects.

Formerly, in a large proportion of cases, treatment consisted of gastrojejunostomy for either gastric or duodenal ulcer. It proved a suitable procedure in many instances because the disease had been allowed to progress to an advanced stage, but, with improvements in both diagnostic and operative technique, and with opportunity for earlier diagnosis, local excision plus gastrojejunostomy have proved to be a satisfactory method of treatment, for gastric ulcer. Approximately 90 per cent of these lesions are situated along the lesser curvature. Eighty per cent of these ulcers are small, and are probably best treated by the method just described. In some instances, resection would be easier from a technical standpoint; but if the ulcer is of moderate size, excision and gastrojejunostomy will give a very satisfactory functional result. In other cases the technical procedure will be simplified by taking out the pyloric end of the stomach with the ulcer.

For a number of years the policy at the clinic has been to recommend surgical treatment to practically all patients with gastric ulcer; but it should be stated that when we carry out the operation, we favor a conservative procedure. Local excision was all that was deemed advisable in 222 instances; although in twenty-nine, malignant change was found in the ulcer at the time of operation. Gastrojejunostomy or gastroduodenostomy was employed in addition to local excision of the lesion in 888 cases of benign ulcer, and in forty-three cases of malignant ulcer. It is not always possible to follow a conservative plan of treatment on account of the large size of the lesion, the depth of the crater, or the extensive induration; consequently one of the more radical plans of partial gastrectomy was deemed advisable in 1092 of these cases. Furthermore, approximately 6 per cent of patients who have gastric ulcer will have multiple lesions which will require partial gastric resection. If the lesion is situated in the midgastric region, segmental resection occasionally is indicated.

In most cases of uncomplicated duodenal ulcer, medical management should be given a trial, and if it is inadequate, a surgical procedure should be undertaken. This is especially true of that unfortunate group of ulcer-bearing individuals who have the extremely high-strung nervous temperament which often accompanies a strong predisposition to ulcer. Since October, 1934, Rivers has used duodenal extract as a supplement to a regulated dietary regimen in more than fifty cases of clinical ulcer, gastritis, and jejunitis. This plan has given much promise, especially in instances in which there was no roentgenographic evidence of a crater. The excellent results which have seemed to come from the supplementary use of duodenal extract are impressive. Complete remission of symptoms has followed employment of 60 to 80 grams of the extract for periods varying from eight days to four weeks. However, sufficient time has not elapsed to justify the belief that the results will be permanent.

There are always some exceptions that must be made, and it is probable that there will be some uncomplicated cases of duodenal ulcer in which experience will indicate that there is nothing to be gained by continuing unsatisfactory medical treatment and delaying operation. However, when operation is employed, the procedure should be as conservative as the situation will permit. The requirements of such an operation include (1) minimal risk, (2) a reasonable chance for complete cure, and (3) ample provision for further operation should conditions require it. Adherence to such a plan is equally necessary in cases in which an operation is imperative on account of hemorrhage, obstruction, or perforation. Under these circumstances, temporizing beyond the point of opportune preparation of the patient only increases the risk.

Two procedures now are available which remove more of the recognized etiologic factors than any of the other operations for duodenal ulcer: (1) lateral anastomosis between the stomach and the first portion of the duodenum, and (2) excision of the cap of the duodenum with the lesion and the anterior two-thirds of the pyloric sphincter muscle, with closure as a gastroduodenostomy. These operations have a better physiologic basis, and are more practical than any anastomosis between the stomach and jejunum, which always provides an opportunity for the subsequent serious complication of jejunal ulcer. Furthermore, there is wider distribution of the food stream, and reduction of physical trauma. In addition, use of either of these procedures permits the acid content of the stomach to empty into the most alkaline portion of the duodenum, which is best fitted to care for this acid material. These two operations should be employed more often than they are.

Acute hemorrhage from a gastric or a duodenal ulcer rarely requires immediate operation, for the hemorrhage is not likely to be fatal, and the operative mortality is likely to be higher than if medical management is provided until the patient's general condition improves. Furthermore, it may not be possible to find the bleeding point if it is small or situated in a region of inflammation, without true ulceration. Of course, acute perforation of a gastric or duodenal ulcer necessitates emergency surgical treatment to save the life of the patient. If the ulcer is of the protected, penetrating type, careful medical supervision may reduce the acute reaction about the lesion, and may permit the operation to be carried out with less risk at a future time.

In selected cases, gastrojejunostomy continues to be a useful operation for treatment of duodenal ulcer. It is particularly satisfactory for older patients, and especially for those who have had symptoms of obstruction. At present, among the clientele of most surgeons in this country, there seems to be no good reason for radical resection of the stomach in cases of duodenal ulcer.

TABLE 1.—*Percentage of Various Operations for Duodenal Ulcer Employed in Different Periods*

Operations	1906 to 1926		1926 to 1933	
	Cases	Per Cent	Cases	Per Cent
Gastrojejunostomy	7,741	86.08	2,673	69.07
Local excision of the lesion	1,113	12.38*	1,014	26.20†
Resection	131	1.45	171	4.42
Pyloric exclusion	8	.09	12	.31
Cases	8,993		3,870	

* In 301 of these cases gastrojejunostomy also was performed.
† In 59 of these cases gastrojejunostomy also was performed.

The trend of selection of operations for duodenal ulcer in the clinic is well illustrated by study of the operations used in the past twenty-eight years (Table 1). Pyloroplasty has afforded very satisfactory results, and its use has been increased 100 per cent in the past ten years; study of 930 cases reveals the operative mortality to be less than one per cent. Lateral gastroduodenostomy also has gained in acceptance, for very few patients who are subjected to this operation require further attention. Resection of the stomach is employed in less than 5 per cent of cases of duodenal ulcer.

A few patients who receive surgical treatment for benign lesions of the stomach or the duodenum do not obtain complete relief, although evidence of recurrence of the original disease cannot be found. Some of these patients have persisting dyspepsia, which may be caused by some unrecognized intra-abdominal disease. In other instances, the symptoms are really insignificant and frequently can be relieved by a change in mode of living, correction of diet, and elimination of foci of infection. In some instances, a jejunal ulcer will form after establishment of anastomosis between stomach and jejunum, even though the operation was judiciously employed and skillfully performed; if further operation is required, establishment of a more nearly normal physiologic relationship of parts of the alimentary tract is indicated.

CARCINOMA OF THE STOMACH

In carcinoma of the stomach there is a place for conservative as well as for radical treatment, for in a few instances the malignant lesion is of such a character that local excision seems justifiable. This is true especially when the neoplasm appears to be in an incipient stage, small, well localized, and in such a position that a more radical operation would be exceedingly hazardous. The results seem to justify continued employment of this form of treatment. The percentage of cures persisting throughout five, ten, fifteen, and twenty years after operation is even higher than that following gastric resection; but this is not inconsistent, for undoubtedly the majority of the lesions treated by conservative operation were discovered while they were in the stage most amenable to treatment. It must also be remembered, however, that the results would be even better if cases were eliminated in which resection was impossible because of inaccessibility of the tumor.

In the more advanced cases of carcinoma of the stomach, including cases of linitis plastica, radical surgical removal of the growth offers the only hope of cure. Consequently, we advocate exploration in all cases unless irremovable metastatic lesions are known to exist. In general, the presence of implants on the rectal shelf, and demonstrable metastasis in the cervical lymph nodes or in the lymphatic structures about the umbilicus, are contraindications to operation. Although roentgenologic examination is of great aid in the diagnosis of carcinoma of the stomach, it cannot be relied on for determination of operability or inoperability in all cases. Even when the abdomen is open, the lesion may appear to be irremovable because of its attachment to the colon or pancreas; but after inflammatory adhesions have been freed, such a growth is often mobilized sufficiently to permit extirpation. Not infrequently, while the surgeon is making exploration in these cases, he observes lymph nodes that appear to be involved, and often they are in a position which precludes carrying out excision with a reasonable degree of safety. Such lymphatic structures, or even a distant nodular growth in the liver, may be of an inflammatory nature. Therefore, the presence of a nodule of indeterminate nature should not contraindicate removal of the primary growth if this can be accomplished satisfactorily. Furthermore, experience often has shown that after removal of the primary cancer the metastatic lesion may regress or at least remain quiescent for a considerable time.

Total gastrectomy probably could be carried out more often than it is; however, the high mortality, and the doubt as to the effect of loss of the entire stomach on the general physiologic processes, have deterred many men from attempting the operation. Several of the ten patients who underwent this operation at the clinic obtained relief for considerable periods; one of them for as long as four years.

In the majority of instances, some form of partial gastrectomy is the operation of choice. If the neoplasm is small and is situated in the pyloric portion of the stomach, the Billroth I operation may be employed; however, resection according to the Polya technique is applicable in a higher percentage of cases. The latter procedure has several advantages: it allows for removal of an adequate portion of the stomach and for wide dissection of the regional lymph nodes and other involved tissues. Furthermore, if recurrence does take place it usually occurs in the liver or other distant structures, and the patient does not suffer the distressing symptoms attending obstruction caused by recurrence of the growth in the stomach itself. Experience in the clinic, with partial gastric resection for carcinoma, seems to justify an optimistic attitude (Table 2).

TABLE 2.—*Results of Gastric Resection for Carcinoma*

Period Lived After Operation	Number of Patients	Percentage of Traced Patients
5 years or more	393	25.0
10 years or more	170	16.4
15 years or more	75	13.5
20 years or more	23	9.3

Although patients who have lived five to ten years after operation are justly considered cured, we operated on a patient who had a recurrence of gastric carcinoma twenty-one years after gastric resection. Recurrences have been known to take place after a period of years, but such an experience is the exception and not the rule. Furthermore, patients who live fifteen to twenty or more years after removal of a carcinomatous growth of the stomach usually have enjoyed normal expectancy.

One should not be content to treat only removable lesions, for it is possible to make life more comfortable for many of the more unfortunate individuals who possess lesions that cannot be eradicated satisfactorily. For example, metastasis to the liver of a patient who is in good general condition should not always preclude palliative removal of an ulcerated, infected gastric lesion. Such a procedure not only removes a painful, sloughing growth, but also circumvents an actual or impending obstruction. At times gastrojejunostomy for relief of obstruction is all that can be tolerated by the patient. This operation may be followed by resection of the growth at a later date, or it may constitute a purely palliative measure. It should be pointed out, however, that because of the poor state of nutrition of the gastric wall, healing is impaired and the mortality following gastrojejunostomy is high.

SARCOMA

Sarcoma is a comparatively rare gastric lesion; only seventy-three cases had been encountered at the clinic up to January 1, 1934. The symptoms of the disease are not sufficiently characteristic to allow the condition to be distinguished from carcinoma; consequently, in most instances the preoperative diagnosis is carcinoma. Partial gastrectomy, combined with roentgen therapy, is the only rational treatment if the growth is resectable, because the postoperative average duration of life of patients for whom only exploration was performed was six months. The operative mortality for the whole group was 12 per cent. The patients whose lesions could be removed were divided into two groups: those who had died since the operation and those who were still living. The average duration of life in the former group was eleven months, and in the latter, four years and four months; the longest survival was nine years. Although the results of treatment have not always been as satisfactory as would be desired, the prolongation of life which is brought about in some of the cases justifies the employment of radical resection when this can be accomplished without undue risk.

POLYPOSIS

The diagnosis of polyposis of the stomach is always difficult to make clinically because, when symptoms are produced, they may simulate those of any type of gastric tumor. The polyps may be single or multiple, and if multiple they sometimes involve the entire gastric mucosa. Balfour and Henderson reported a group of fifty-eight cases of benign gastric tumor, and noted that gastric polyp, comprising 20 per cent of the entire series, occurred more frequently than any other type of lesion. The lesions in cases of multiple gastric polyp are rarely malignant, whereas single polyps frequently undergo malignant transformation. In our experience, 50 to 60 per cent of single gastric polyps develop malignant characteristics; consequently, wide excision of the stomach adjacent to the tumor is the preferable procedure to carry out in their treatment. If the polyps are situated in the lower end of the stomach, resection of the Billroth I or the Polya type may be employed. However, in those instances in which the lesions are situated high on the posterior wall, or in the fundus, segmental resection of the stomach, or transgastric excision, often is all that can be accomplished.

SYPHILIS OF THE STOMACH

Gastric syphilis is not as rare as it has been thought to be. The reason for this is that the symptoms are easily confused with those of chronic ulcer, carcinoma, and hour-glass contracture of the stomach. Consequently, the diagnosis is usually made late in the course of the disease, unless phenomena of obstruction develop as a result of narrowing of the pyloric outlet. However, even when retention is present in cases in which syphilis is suspected, surgical treatment should be deferred until there is proof that adequate antisyphilitic treatment will not relieve the condition that is causing the obstruction. Young individuals usually respond to this therapy. In treatment of elderly patients, temporizing is not justifiable if the lesion is resectable, and especially if the symptoms are of recent origin, if there is a palpable mass in the epigastrium, if pus and blood are found in the stomach, and if there is occult blood in the stool. Even if an error has been made in the diagnosis, the surgeon who operated has acted wisely. Surgical treatment is clearly indicated in the presence of hour-glass contracture of the stomach; for the deformity once established is not only permanent, but probably will increase from further contracture of scar tissue.

TUBERCULOSIS OF THE STOMACH

Gastric tuberculosis is rare. In study of gastric material obtained at operation and at necropsy, the incidence among patients at the clinic has been only 0.34 per cent. The diagnosis is difficult to make because of the ease with which the disease may be confused with gastric ulcer and carcinoma. The gross appearance of the lesion may be that

of an ulcer, a tumor, or diffuse scarring of the stomach. Radical resection of the involved portion of the stomach is the treatment that affords relief. Since the requirements are surgical, inability to arrive at an accurate differential clinical diagnosis is not likely to be as disastrous as it might be under some other conditions.

SUMMARY

Careful preoperative preparation has reduced the mortality of surgical procedures applicable to the upper part of the gastro-intestinal tract, and as a consequence of a supervised regimen after operation, better end-results have been obtained.

Satisfactory methods of solving many of the problems imposed by the presence of lesions in the stomach and duodenum now are available. Marked progress toward more complete mastery of the situations undoubtedly will be delayed until more is learned about the etiology and pathogenesis of the lesions and about the chemistry of the body.

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ON THE SURGERY OF GLAUCOMA: MODE OF ACTION OF CYCLODIALYSIS*

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THE observation, by E. Fuchs,[1] of hypotony, associated with choroidal detachment following cataract extraction, suggested to Heine[2] the thought of similarly softening the glaucomatous eye by establishing a communication between the anterior chamber and the suprachoroidal space through surgical means. He was encouraged in his idea by the knowledge, as shown by anatomical specimens, that in absolute glaucoma, with complete obliteration of the filtration angle, the suprachoroidal space remains patent for a long time, perhaps permanently so. He hoped that as in traumatic iridodialysis, the ciliary body or iris root usually shows no tendency to heal on again, the surgically detached ciliary body would also remain detached during the healing process, and that thus a permanent communication between the anterior chamber and the suprachoroidal space would be established, or that with the help of a myotic, at least a capillary cleft would remain, which would be sufficient to permit of outflow of aqueous into the suprachoroidal space.

HEINE'S INTERPRETATIONS

Heine's original idea has been supported by several facts. Thus in some cases after cyclodialysis, a flat peripheral choroidal detachment has been observed with the ophthalmoscope. It seemed questionable to him, however, whether the permanency of its action could be explained in this way. In those cases which have come to anatomical examination, because of the failure of control of tension, a reattachment of the iris root is, of course, found. But what of the many successful cases which constitute the majority? One such case has been examined anatomically, that of Elschnig.[3] Histological examination of the eye, the tension of which had been permanently normalized by cyclodialysis fourteen years previously, showed a free angle, patent Schlemm's canal and a communicating cleft between the anterior chamber and the suprachoroidal space within the area of operation. On the opposite, nonoperated side the angle was closed and Schlemm's canal mostly obliterated. Elschnig believes the formation of the cleft to have been the major agent in reducing the tension of this case. He does not, however, exclude reduced production of aqueous resulting from damage to the ciliary body as a possible factor, nor does he believe the freeing of the angle to have been a factor because the pectinate ligament (corneoscleral trabeculum) within this region appeared so sclerosed and compressed as to probably render filtration impossible. This case then shows that the success of the operation *may* depend upon a communication between the anterior chamber and the suprachoroidal space.

VIEWS OF OTHER AUTHORS

Some authors believe that the improved circulation within the iris vessels—these vessels had been bent at right angles by the peripheral iris adhesions and are straightened out by the operation—affords the opportunity for increased absorption of aqueous. Filtration through the scleral scar does not come into question. Others suggest that restitution of the filtration angle, by separation of the peripheral iris adhesions from the angle wall, or scraping off the pathological endothelium in the angle with secondary regeneration when the ciliary body heals on again, are factors. Heine feels this a possibility, but remarks that it would be a difficult thing to show anatomically and to disprove the presence of a capillary cleft in the region of the cyclodialysis.

We, therefore, do not yet possess a histological explanation of the action of cyclodialysis and must as yet content ourselves with the discussion of theories such as the ones mentioned above which deal with the reëstablishment of normal absorption or outflow. Other theories deal with the thought of reduced formation of aqueous through atrophy of the ciliary body following section of its nerves and vessels of supply (R. Salus,[4] Kraus[5] and Meller.[6]) According to E. Bunge,[7] such a partial atrophy of the ciliary body, which already shows some general atrophy due to the glaucomatous process, has not been accepted as proven.

MODE OF ACTION OF CYCLODIALYSIS STILL REMAINS AN OPEN QUESTION

The mode of action of cyclodialysis remains, therefore, an open question to date. The importance of arriving at the true explanation of the action of the operation is evident. Our surgical

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